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Standard Practice for Underground Installation of Thermoplastic Pressure Piping[1]

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This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

INTRODUCTION

In general, thermoplastics pressure piping materials behave as ductile materials under load, meaning that they can undergo considerable deformation without damage. Piping made from such materials has the ability to bend under a load without breaking and to deform in other ways, while offering continued resistance. This flexibility allows ductile thermoplastic pipe to activate through pipe deformation lateral soil forces which create a pipe/soil system capable of safely supporting–even in pipes subject to little or no internal pressure–the earth and superimposed loads which are encountered in most pipe installations. However, proper installation techniques are required to ensure that the necessary support at the bottom and passive soil pressures at the sides of the pipe are developed and maintained.

Soils in which trenches are dug should be examined and identified and the trenches prepared and backfilled in accordance with sound bedding procedures and this practice.

1. Scope

1.1 This practice covers procedures and references ASTM specifications for undreground installation of thermoplastic pressure piping, 63-in. (1372-mm) nominal size and smaller. It is beyond the scope of this practice to describe these procedures in detail since it is recognized that significant differences exist in their implementation depending on kind and type of pipe material, pipe size and wall thickness, soil conditions, and the specific end use.

1.1.1 This practice assumes that over the range of anticipated operating conditions, including maximum external loading and minimum internal pressure, the soil/pipe system will offer sufficient structural stability to resist possible excessive diametrical deformation, or even collapse. In cases, particularly with large diameter thinner-walled pipe, for which the validity of this assumption may be in question, the selection of pipe and recommended installation conditions should be determined by a qualified engineer.

1.1.2 Specific pipe characteristics and end-use requirements may dictate addition to, or modification of the procedures stated or referenced herein.

1.2 The values stated in inch-pound units are to be regarded as the standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in Sections 10 and 11.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1600 Terminology Relating to Abbreviations, Acronyms, and Codes for Terms Relating to Plastics[2]

D 2487 Test Method for Classification of Soils for Engineering Purposes[2]

D 2488 Practices for Description and Identification of Soils (Visual-Manual Procedure)[2]

F 412 Terminology Relating to Plastic Piping Systems[2]

2.2 *AWWA Standard:*

C 651 Standard for Disinfecting Water Mains[3]

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions are in accordance with Terminology F 412, unless otherwise specified. Abbreviated terms are in accordance with Terminology D 1600. Installation terminology used in this practice is illustrated in Fig. 1.

3.1.2 The term pipe refers to both pipe and tubing, unless specifically stated otherwise.

[1] This practice is under the jurisdiction of ASTM Committee F-17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.61on Water Pipe.

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[2] *Annual Book of ASTM Standards*, Vol 08.04.

[3] Available from American Water Works Association, 6666 W. Quincy Ave., Denver, CO 80235.

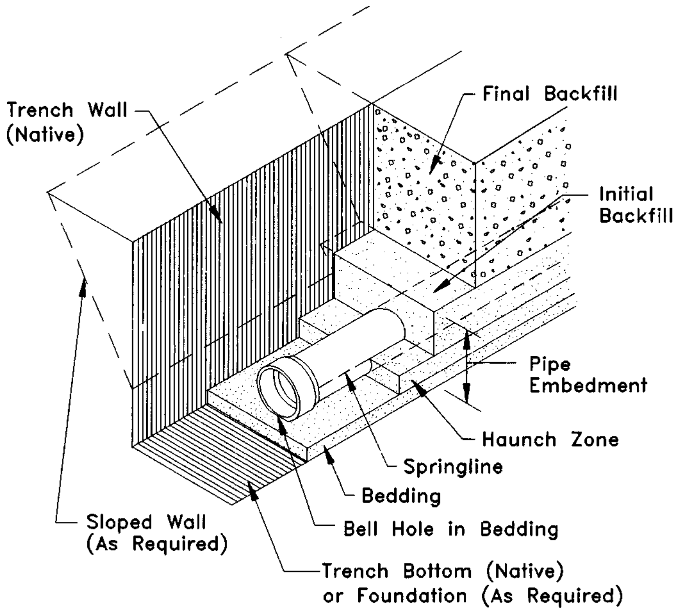

FIG. 1 Installation Terminology

4. Significance and Use

4.1 This practice may not apply to products which may be subject to failure at relatively low strains. For such lowductility materials, the installed pipe/soil system must be sufficiently rigid to prevent pipe deformations which could strain the piping material beyond its safe strain limit.

5. Joining

5.1 Plastic pipe may be joined together or to other pipes of dissimilar material using a number of different techniques. Commonly used procedures, joining materials, and fittings are defined by various standards. (See Appendix X1.) The technique used must be suitable for the particular pipes being joined to one another. Manufacturers should be consulted for specific instructions not covered by existing specifications. When requesting information, the intended service application should be made known.

5.2 Skill and knowledge on the part of the installer are required using recommended techniques to obtain quality joints. Training of new installers should be made under the guidance of skilled individuals. Detailed written procedures and visual aids used to train personnel are available from piping and joining equipment manufacturers.

5.3 The use of fittings and joining procedures which are not covered by a recognized standard is subject to the judgment and discretion of the purchaser. Each fitting and joining procedure used should be qualified by investigation, testing, and experience to establish its suitability and safety for the intended service. Fittings and joints shall have long-term pressure capabilities equal to or greater than the system's maximum anticipated sustained operating pressure.

5.3.1 Thrust transmitting joints such as heat fused or solvent cemented, should be capable of restraining maximum anticipated pipe pull-out forces which may be generated by internal pressure or pipe expansion/contraction, or both. Gasketed and other non-thrust transmitting joints should be restrained by means of properly engineered external restraints or joint restraint devices (see 7.3).

6. Trenching

6.1 *Trench Stability*—The trench should be excavated to ensure the sides will be stable under all working conditions. The trench walls may be sloped or appropriate supports provided to comply with all applicable local, state, and federal requirements for safety.

6.2 *Trench Width*—The width of the trench at any point below the top of the pipe should be sufficient to provide adequate room for each of the following requirements: (*1*) joining the pipe in the trench if this is required; (*2*) snaking of small-diameter, fixed-joint-type pipe from side-to-side along the bottom of the trench, when the effects of contraction are not otherwise accommodated; (*3*) filling and compacting the side fills; and (*4*) checking the elastomeric seal joints. Minimum trench widths may be utilized with most solvent-cemented and heat-fused pressure pipe materials by joining the pipe outside the trench and lowering the pipe into the trench after adequate joint strength has been attained (see 10.4).

6.3 *Trench Bottom*—The trench bottom should be prepared for the direct replacement of the pipe and should be continuous, relatively smooth, free of rocks, and provide uniform support. For bell-ended or coupled pipe, suitable "bell-holes" should be provided at each joint to permit the joint to be assembled and the pipe to be supported properly.

6.3.1 Where ledge rock, hardpan, or boulders are encountered, it is advisable to pad the trench bottom with a bedding of at least 4-in. (100-mm) thickness of compacted granular material. In situations where rapid movement of water may take place through this bedding, the granular material used should have gradation that will prevent loss by migration of any pipe embedment material (see 9.8).

6.4 *Trench Depth and Pipe Cover*—Excavation for pipe trenches should be to the lines, grades, and dimensions shown on the contract drawings. Sufficient cover should be maintained to adequately reduce the traffic or other concentrated and impact loads.

6.4.1 Reliability and safety of service may assume major importance in determining minimum cover for any intended service. Local, state, or federal codes may also govern. Pipe intended for winter water service should have a minimum cover equal to or greater than the maximum expected frost penetration depth.

6.4.2 A minimum cover of 24 in. (610 mm) is considered desirable for pipe subject to heavy overhead traffic. In areas of light overhead traffic a cover of 12 to 18 in. (305 to 457 mm) is usually considered sufficient.

6.5 *"Trenchless'' Installation*—Some types of thermoplastic pressure pipe may be installed by using methods which do not require excavation. They may be applied by either mechanical means, by solvent cementing, or by fusion joining, to either the main or service line, or both.

7. Pipe Placement

7.1 *Pipe Joint Assembly*—Pipe assembly shall be conducted in accordance with the manufacturer's published recommendations. Pipe joined by solvent cementing, heat fusion, or some other thrust transmitting connection may be joined above ground. After the joint is appropriately "cured" (see Section 10) the pipe can be lowered into the trench.

7.2 *Pipe Bending*—Assembled thermoplastic pipe may be bent longitudinally if the bending radius is within limits prescribed by the manufacturer. There may be two limits, one for pipe without joints and the other for pipe sections with joints.

7.3 *Thrust Restraint*—When installation piping systems with joints which cannot transmit the anticipated maximum longitudinal thrust, thrust restraint may be necessary at certain points in the system, such as changes in direction, or terminal ends, to prevent joint disengagement.

7.4 *Service Connections*:

7.4.1 *General*—Service connections on thermoplastic pipe may be made by means of a suitable saddle, tapped coupling, direct taps, or service connector. These should be installed in accordance with the manufacturer's published recommendations.

7.4.2 *Live Tapping*—Service connections for tapping of pressurized lines are commercially available. Installation by the proposed trenchless methodology shall only be specified after consultation and approval of the piping manufacturer. The specific published manufacturer's recommendations for each design should be followed when making a live tap.

7.4.3 *Bends in Service Pipe*—When establishing the location of the tap, consideration should be given to minimizing service pipe bends near tap and house connections, since soil settlements at these points could result in excessive shear or pull-out loads. Bends in the service pipe should generally not be closer than 10 pipe diameters from any fitting or valve. The pipe should not be bent beyond the limits recommended by the manufacturer. In the case of coiled pipe, these limits are often more restrictive when bending the pipe against the natural curvature than with the curvature. Service pipe or tubing which becomes kinked during bending, handling, or installation should not be used. Take care in locating pipe bends and in conducting backfill operations to ensure that kinking will not develop during or after installation.

7.4.4 *Service Connections*—Depending on the materials used and the recommendations of the pipe manufacturer, flare, insert, compression, solvent-cement, or heat-fusion type fittings may be employed to connect service pipe or tubing to itself and to the corporation and curb stops. When compression fittings with an internal stiffener are used, select a type which will ensure that the internal stiffener will not move from its proper position prior to and during tightening. The stiffener should be a continuous annular section (tube), snugly fit in the pipe, providing support in the entire area under the gasket and compression element. Each pipe connection may use a separate stiffener. Precautions for precluding possible problems which could be occasioned by differential settlement of flexible pipe with more rigidly held connectors include the following:

7.4.4.1 Take extra care during bedding and backfilling to provide firm and uniform support for the pipe or tubing at the point of connection.

7.4.4.2 Consult the pipe and fitting supplier for application suitability and installation instructions.

7.4.4.3 Place a protective sleeve or shield (which can consist of a short section of plastic pipe split lengthwise) over the connection and short section of pipe if protection is needed against possible differential settlement.

8. Appurtenances

8.1 Valves, hydrants, fittings, and other appurtenances should be provided and installed as shown on the contract drawings or specifications.

8.2 The weight of valves, hydrants, and fittings should be separately supported and not be carried by the plastic pipe. The support should also be designed to protect the plastic pipe against excessive torsional or other loads which may develop when the valves or hydrants are operated.

8.3 Valves, hydrants, and fittings should be adequately anchored against movements in the axial direction when connected to pipe by a joint not designed to transmit axial thrust. When using such joints, consideration should be given to the extent of pipe movement within the socket as a consequence of thermal expansion/contraction or axial thrust.

8.4 Consideration should be given to the design capacity of each joint in the system to safely resist maximum anticipated axial thrust. Special anchoring or restraint-type joints may be required to compensate insufficient thrust resistance. The pipe manufacturer should be consulted for joint thrust capabilities and anchoring recommendations.

9. General Requirements for Bedding and Backfill

9.1 The pipe should be uniformly and continuously supported over its entire length on firm stable material. Blocking should not be used to change pipe grade or to intermittently support pipe across excavated sections.

9.2 Pipe may be installed in a wide range of native soils. The pipe embedment should be stable and placed in such a manner as to evenly support and physically shield the pipe from damage. Attention should be given to local pipe laying experience which may indicate solutions to particular pipe bedding problems.

9.3 The pipe embedment materials should be stable, sufficiently granular to be readily worked under the sides of the pipe to provide satisfactory haunching, and readily compactable to achieve soil densities specified by contract documents. These qualities are available in the following materials:

9.3.1 Gravels and sands classified as Soil Types GW, GP, SW, and SP, or by a dual soil classification beginning with one of these symbols, in accordance with Test Method D 2487.

9.3.2 Sands and gravels classified as Soil Types GM, GC, SM, and SC in accordance with Test Method D 2487.

9.4 Initial backfill materials should be placed in compacted layers.

9.5 All native and other materials in the pipe embedment zone should be free from refuse, organic material, cobbles, boulders, large rocks or stones, or frozen soils.

9.6 The particle size of material in contact with the pipe should not exceed the following: ½in. for pipe to 4-in., ¾ in. for pipes 6 to 8 in.; 1 in. for pipes 10 to 16 in.; and 1½ in. for larger pipes. Each soil layer should be sufficiently compacted to uniformly develop lateral passive soil forces during the backfill operation.